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ABSTRACT

This paper proposes a conceptual framework based on different levels of analysis using the metaphor of the layers of an onion to help organize and structure thinking on research issues concerning training. It discusses the core of the "analytic onion," the biological level, and seven levels of analysis that surround that core: the individual, the group, and the organizational, community, societal, world, and space systems. Interactions between the levels are also considered. Disciplinary perspectives from biology, psychology, social psychology, political science, and sociology are presented; all are viewed as having contributions to make to the examination of training issues when the focus is on the appropriate level of analysis. The paper argues that using a single disciplinary perspective may result in missing many alternative training solutions to operational problems or solutions to training and operational problems that do not appear at first glance to be related to training or operations. Research issues and/or research questions are identified at each level of analysis. Contains 43 references. (YLB)

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THE ANALYTIC ONION: EXAMINING TRAINING ISSUES FROM DIFFERENT LEVELS OF ANALYSIS

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September 1991

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The layers found in an average grocery store onion, perhaps of the sweet Vidalia variety, are used as an analogy for levels of conceptual analysis. This paper focuses on applying the "Analytic Onion" to training issues. The core of the analytic onion is the biological level, surrounded by the individual, the group, the organizational, community, societal, world system, and space system levels of analysis. Each level of analysis is discussed in the paper as well as the interactions between the levels. Disciplinary perspectives from biology, psychology, social psychology, political science, and sociology are presented. All of these disciplines are viewed as having contributions to make to the examination of training issues when the focus is on the appropriate level of analysis. This paper presents these varied perspectives in a unitary fashion and argues that using a single disciplinary perspective may result in missing many alternative training solutions to operational problems or solutions to training and operational problems which do not appear at first glance to be related to training or operations.

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PREFACE

The ideas and information presented in this paper are the result of in-house investigations which should lead to enhanced examination of major training issues and potentially lead to a more effective implementation of training solutions to enhance operational performance.

THE ANALYTIC ONION: EXAMINING TRAINING ISSUES FROM DIFFERENT LEVELS OF ANALYSIS

SUMMARY

This paper presents different levels of analysis, ranging from the biological systems to space systems, by which many research issues concerning human behavior may be investigated. The thrust of this analysis is to more accurately define the many different factors which influence training effectiveness in the Air Force (AF). The authors argue that many solutions to training problems focus on only one level of analysis and therefore provide only partial answers.

Those of us who wear glasses get used to it and hardly notice it. We even get used to tints, bifocals, and trifocals. It's not until things get out of focus or we're getting eyestrain and headaches that we know it's time for new glasses. New glasses enable us to see what we had not seen before, had not been clearly in focus, or was somewhere on the periphery of our visual world. Similarly, we sometimes look at our work through a set of glasses and may not see some issues, concepts, theories, and opportunities because of a too limited focus on what the problems are and what the potential solutions may be. This paper attempts to define and structure other ways of looking at training issues, that is, grind some new lenses for our professional glasses, hopefully, without rose-colored tinting.

INTRODUCTION

Air Force (AF) research and development efforts have been quite successful in identifying the psychological factors which have an impact on the many jobs which airmen perform. Innovative ways of improving selection, classification, assignment, retention, and training have been developed using primarily psychological theories and methods.

There are social psychological and sociological methods and areas of analysis which may also contribute to improving training to enhance mission capability. Sociologists long have been involved in the types of analyses which may be of use to the Air Force (Stouffer, 1949; Moskos, 1970; Janowitz & Little, 1974). Recent research by social demographers indicates that the population structure of the United States is changing. The characteristics of the available pool of recruits therefore will be changing. The nature of the available recruit pool in terms of aptitudes, primary language, cultural practices, sex ratio, educational attainment, and minority representation may change in significant ways. The training community needs to be aware of these shifts and adjust accordingly. This paper focuses on identifying areas of research in these disciplines which show value to the AF training mission.

CONCEPTUAL FRAMEWORK

A conceptual framework based on different levels of analysis is proposed here in the form of an "analytic onion" in Figure 1 to help organize and structure our thinking. There are several different levels of analysis from which humans and human activity can be investigated which can be conceived as being in layers like an onion. The *biological* is the most basic level of analysis, and researchers at this level have furthered our understanding of human anatomical structures and physiological processes, our relationship to other life forms and the processes by which our species evolved. The *individual* level of analysis is one which focuses on the cognitive and behavioral aspects of individual humans in their relation to their environment as the empirical unit and is most often thought of as the domain of mainstream psychology. *Groups* are the next level of analysis, that is, small groups of humans numbering from 2 to about 15,

who are interacting and mutually influencing each other. These studies examine intra- and inter-group processes and structures and traditionally fall into the realm of social psychology whether in psychology or sociology. The study of *organizations* focuses on large human conglomerations which vary in purpose, complexity, size, and rigidity, and is a line of research in sociology and psychology. A *community* consists of people who live near one another, as a result frequently interact and develop a sense of unity based on common cultural traits and values. *Societies* are the next level of analysis. These are the sovereign nation-states formed by humans to satisfy basic social needs for value identification, structure, subsistence, reproduction, socialization, and meaning. Research on societies is found in sociology, economics, political science, anthropology, and history. The *world system* is the next level of analysis. The world system level of analysis focuses on the dynamic and cyclical interaction of nation-states characterized by exchange relations. These studies are usually found in sociology, political science, and economics. The *space system* level of analysis is somewhat forward-looking in that we do not yet have existing human populations in space. However, this level of analysis is proposed as being necessary for future research which should find that understanding human activity and the spread of humans through the cosmos is conceptually very different in this environment and will require a new level of analysis. This conceptual framework is presented to help track and organize the great variety of socio-cultural phenomena which may have an impact on AF training. There is overlap in that each level influences in greater and lesser ways each other level.

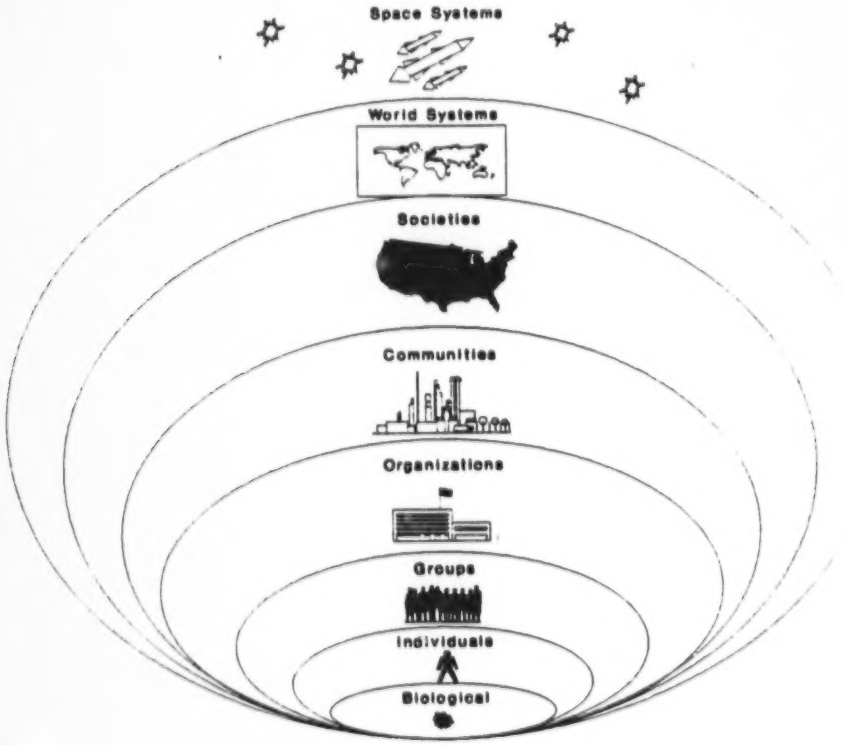

Figure 1. The Analytic Onion.

A great deal of research has been done and continues to be done which focuses on the biological and individual levels of analysis to enhance training effectiveness and mission capabilities.

This paper examines the group, organization, societal, and world systems levels of analysis for their potential applications to the same ultimate goal of mission capability.

As we continue to reap the benefits of the present mode of research which focuses on the biological and individual levels of analysis we should simultaneously explore the application of current and possible R&D on groups and organizations to the variety of AF missions.

INTERACTIONS BETWEEN LEVELS OF ANALYSIS

In our discussion of different levels of analysis, it is important to keep in mind that each level of analysis influences, to a greater or lesser degree, each other level. No one level by itself can give us the complete picture; each level adds its own unique dimension to our picture. Undoubtedly, some levels of analysis are more appropriate to certain problems than are others. However, AF training research and training technologies can only be facilitated, and not hindered, by giving due consideration to all perspectives.

People issues, like those the AF must deal with on a daily basis, are complex; consequently, so is the job of the social scientist. People react to many different things, in many different ways, and for many different reasons. They react to themselves, to their environment, to the people around them, and to the society in which they live. Some adapt to their environment, others change their environment and still others succumb to the environment and die. Simply stated, people issues are complex because people are complex. Their behavior is the consequence of numerous factors interacting at, and across, different levels of abstraction.

There are researchers who have proposed that the individual level of analysis which is the focus of present day psychology is a function of the prevalent values and social structures of the modern world. Sampson (1989) proposes that the premodern, modern, and emerging postmodern forms of social order have and will continue to influence our conceptions of the individual. His notion is that the emerging postmodern form of social order with its emphasis on global structures, issues, dynamics, and a variety of concerns will bring with it a new understanding of the individual person. One of the major theories concerning this "globalization" is found in world system analyses which is presented later in this paper.

There have been many other efforts to develop theories and explanations of human behavior which are not limited to one level of analysis. Physiological sociology is an example of an attempt of certain social scientists to understand the variety of findings in human and nonhuman primate studies which correlate some forms of social behavior with physiological measures such as aggression and testosterone levels (Barchas, 1976; 1984; Barchas & Mendoza, 1984; Mazur & Robertson, 1972; Mazur & Lamb, 1980). These appear to be very complex relationships in which individual physiological responses may be cause or effect or are mediated by the social situation. The issues are not easily studied and require careful controls but our point here is that these are theoretical and empirical attempts to examine human behavior from more than one level of analysis and appear promising.

Psychophysiologists and neuropsychologists are also at the forefront of looking at multiple levels of analysis to understand human behavior. For example, Cacioppo (1982) offers an analysis of the relationships of physiological responses and traditional social psychological variables. In our view, these all offer exciting attempts with great potential for understanding human behavior as a function of many different factors from different levels of analysis.

BIOLOGICAL AND INDIVIDUAL LEVELS OF ANALYSIS

Group, organizational, and societal level phenomenon do not occur in isolation. They interact with one another as well as with phenomenon at the biological and individual levels. Thus, while we are primarily concerned with exposing the potential benefits of more macro level analysis, our discussion would not be complete without a brief discussion of biological and individual level analysis. In other words, the sociologist can miss the trees for the forest just as easily as the psychologist can miss the forest for the trees.

Biological Level

The human biology is the most fundamental level at which researchers may examine training and mission capabilities issues. Human anatomy and physiology dictate many AF training policies and design considerations. Examples of this are abundant and readily apparent. For example: persons with poor eyesight are precluded from flight training; flight simulators and other training equipment are designed according to various anthropometric charts; and, aircrews are trained to operate in adverse environments where low pressure inhibits the diffusion of oxygen into the blood.

Although research and analysis at the biological level can be extremely complex, it is largely an objective endeavor—a person can lift a certain amount of weight or sustain a certain number of g's before losing consciousness. The labeling of biology as a "basic (or hard) science" is attributed to the objectivity inherent in its analysis; subjectivity *appears* to play little, if any, role in this level of analysis. However, biological phenomenon do not occur in isolation. Biology is intimately linked to the more subjective realm of psychology and individual behavior.

Moreover, the relationship is two-way. A chemical imbalance within the brain—a biological and seemingly objective condition—can produce mental disorders which prevent a person from adapting to their environment. In the reverse situation, a person's ability to perform a simple motor task may be hindered or facilitated by their mental state—self-perception, attitudes, motivation. Similarly, psychosomatic illnesses are biological manifestations of psychological states.

The linkages between the biological and individual levels of analysis clearly exist and are well recognized. They are studied in many fields including engineering psychology, neuroscience, psychiatry, and human factors engineering. Each of these disciplines seeks to further our understanding of the these linkages and apply that understanding to such endeavors as the development of man-machine interfaces, the treatment of schizophrenia, and the like. On a more mundane level, for example, these linkages are exploited through the use and abuse of mind altering drugs and through incredible mind-over-matter feats.

Individual Level of Analysis

The individual level of analysis is composed of many different perspectives, including behavioral psychology, cognitive psychology, educational psychology, clinical psychology, and others. Yet, despite the differences between these perspectives, they are bound by a common denominator—the individual. The individual level of analysis tends to dominate the behavioral and social sciences, and consequently, much of the research conducted in the area of training is also based on the individual. For example, measures of attitude (e.g., expectations), motivation, perception, and values have long since been researched as potential predictors of training and job performance (Milton, 1981).

The list of studies based on the individual is long and varied. Individual analysis has been, and continues to be, a fruitful approach to studying training issues. However, the individual level of analysis is not always the most fruitful approach, nor the most appropriate. Many research questions are best answered at a different level of analysis. Reductionism, whether psychological, sociological or somewhere in between, tends to narrow our vision. The objective of this paper is to make the reader aware of the potential utility of alternative levels of analysis.

GROUP LEVEL OF ANALYSIS

The power of groups cannot be overstated. Some social psychologists tell us that it is through group interaction that we even have a sense of self. The "Looking Glass Self" is formed in group interactions, of course, some groups are more important than other groups, thus we have a recognition of "primary" groups (Cooley, 1909) and "significant others" (Sullivan, 1964). Groups have the power to move us to acts of great accomplishment or to acts of great revulsion. The soldier who stays in his bunker with his comrades and defends a position against an onrushing enemy when his feet are itching to run in panic is influenced largely by group factors. The mass suicide in Jonestown, Guyana, also was largely a result of group influences. The stories of cannibalism in isolated air crashes also illustrates the extreme power of groups to effect our behavior.

There is a good deal of current research being done on groups in the academic community and in the other services. Most notably, the Army Research Institute (ARI) has launched a substantial research effort on groups focusing on group cohesion. The results appear to support their belief that substantial gains may be made by paying attention to these factors in organizations, leadership, morale, and task performance (Seibold, 1988, Kelley, 1988).

This section deals with what groups are (sometimes referred to as small groups in the literature), that is, how we define them, some basic characteristics of groups, some categories of group tasks, groups in the operational AF environment, examples of some problems, and some research questions which need to be addressed.

What Groups Are

It is critical when discussing any concept to have an agreed upon definition to structure thought, theory, and research. In group research there are quite a number of subtly different definitions of groups. Shaw (1981, p. 8) proposes that,

> "A group is defined as two or more persons who are interacting with one another in such a manner that each person influences and is influenced by each other person."

In a classic work, Robert Bales (1950, p. 33) defined groups as:

> "Any number of persons engaged in interaction with each other in a single face-to-face meeting or series of meetings, in which each member receives some impression or perception of each other member distinct enough so that he can, either at the time or in later questioning, give some reaction to each of the others as an individual person, even though it be only to recall that the other person was present."

George Homans (1950, p. 1) states:

> "We mean by a group a number of persons who communicate with one another often over a span of time, and who are few enough so that each person is able to communicate with all the others, not at second hand, through other people, but face-to-face."

Sherif & Sherif (1956, p. 144) also offer their own definition:

> "A group is a social unit which consists of a number of individuals who stand in (more of less) definite status and role relationships to one another and which possess a set of values or norms of its own regulating the behavior of individual members, at least in matters of consequence to the group."

It is not necessary for us to decide upon a definition of groups here. It is necessary to point out that whatever definition of groups evolves in AF research should reflect empirical research and practical application considerations as well as theoretical insight. Homans' and Bales' definitions offer operational definitions which greatly influenced small groups research for years and focused on face-to-face interaction and thus are good for some types of groups and some practical considerations. Shaw has a similar definition but focuses on mutual influence patterns and does not emphasize face-to-face interaction. Sherif and Sherif's definition is useful because it highlights both the structure (statuses and roles) and dynamics (regulating mechanisms) of groups. They all set lower and upper size guidelines of 2 to about 20.

Characteristics of Groups

There are many researchers who have tried to define and characterize small groups. Most of these researchers begin as we always begin in science, that is, by describing the object of study. By describing them we eventually are able to define what they are and what they are not. In the descriptive stage we develop identifying characteristics which distinguish the object. Although still a relatively new area of research, group researchers have been able to distinguish some identifying characteristics. A very useful set of group characteristics is proposed by Forsyth (1983). In his typology, groups are characterized by interaction, structure, groupness, and dynamic interdependency. *Interaction* refers to verbal, nonverbal or physical communication between the members. *Structure* refers to the pattern of roles, statuses and norms that develop and endure in a group. *Groupness* refers to the extent of "we-feeling" that exists in the group, that is, the degree to which the members define themselves as a group. *Dynamic interdependency* refers to the tendency for groups to be constantly changing, developing, and ending and thus are in varying states of dynamic equilibrium. The dynamic nature of groups is at once obvious and striking to a researcher. Taken together, these characteristics differentiate groups from other social groupings of the same size. Figure 2 illustrates two examples of groups plotted on a graph which supposes that we could measure all four basic characteristics. If nothing else, these characteristics help us to define what are not groups.

There are a number of subcharacteristics of groups which in some way fit into one of the four major characteristics above. These subcharacteristics include conformity, deviancy, power, leaders and leadership, environmental factors, inter-group interaction, group composition, coalition formation, groupthink, deindividuation, cohesion, and group tasks and goals. Research continues on these subcharacteristics and, of course, particular researchers tend to identify the one they are working on as the most important.

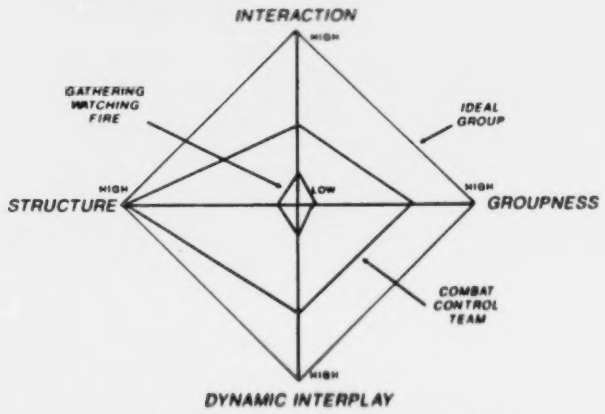

Figure 2. Group Characteristics.

Group Goals and Tasks

The emphasis on the mission in the AF dictates that we be very practical and focus on specific types of goals and tasks which are relevant. Groups have goals which serve as motivators for behavior in much the same way that they do for individuals. Goals may come from an external source as in a chain of command or from within the group. Shaw (1981, p. 350) defines group goals as "an end state desired by the majority of the group members."

Tasks are the means by which groups achieve their goals. Group tasks are different from individual tasks in significant ways because they involve coordination and integration of the activities of group members. The group members will vary on all of those characteristics we know individuals vary but will also vary in commitment to the goals, tasks, and other group members.

There are a number of different task typologies available to us which may serve as a starting point to develop one suitable for AF purposes. Steiner (1972) classifies group tasks as disjunctive or conjunctive, additive or discretionary, maximizing or optimizing, and divisible or unitary. Shaw (1981) suggests several other dimensions of group tasks which need to be considered such as difficulty, solution multiplicity, intrinsic interest, cooperation requirements, intellectual-manipulative requirements, and population familiarity. The main point of group task research is that group tasks are, indeed, different from individually performed tasks. With that fact in mind we should construct training systems to maximize performance of group tasks.

There are many tasks performed by groups or teams rather than individuals alone in the AF. Coordinated efforts are common in many areas...perhaps it is easiest to see in aircrews. Outside of aircrews there has been little done to maximize training for performance of group tasks. Research is needed to identify group-performed tasks in selected AFSs and to determine how to best train these tasks.

The nature of the tasks being performed is important to defining whether they should be performed by groups or trained in a group setting. Some tasks require that group members perform the *same task with simultaneously coordinated actions* such as in a tug-of-war or wing walking an aircraft. Other tasks require each individual perform *different but simultaneously coordinated actions* such as in football or airbase ground defense by security police, combat control teams, air rescue teams, or flight crews. Still other tasks require *sequential coordinated actions* performed as a series of tasks by a number of individuals such as on an assembly line or when replacing the battery in an F-4 which requires the egress technician to first remove the ACESII ejection seat and then a crew chief to replace the battery.

By identifying and capitalizing on the group and team performance characteristics of AF tasks we may be able to more effectively utilize or assist lower aptitude personnel in task performance, and allow all personnel to learn leadership, teamwork, and cohesion skills on-the-job. Competition between groups and teams may increase learning, performance, and morale. Cooperation within groups and teams also may increase learning.

Groups in the Air Force

The group skills acquired in many training settings probably will transfer to the operational setting because a great many tasks are already performed by teams, such as fuel cell repair, wing walking, and airbase ground defense to cite a few examples.

Other research considerations include investigation of the team concept in aircraft maintenance. When effectively used, a team concept may aid in dispersed operating location operations in which several technicians may be able to perform a task. The team concept in maintenance may be the vehicle by which the consolidated, generalist AFSs of the future are able to operate. Technicians will have more things, that is, job-aids and computers for information, analysis, and trouble-shooting, but they will still need to rely on an overlap of skills with other maintenance technicians to accomplish a mission and launch aircraft. Each member of the team would probably be an expert in one area, and the others will cross-train widely and naturally by simply being there to assist.

Research could be done to determine whether these teams should remain static and rotate permanent assignments as teams with individuals occasionally being promoted to higher supervisory positions or some other manning and assignment system is better. Maintenance teams could also be the basis for the esprit de corps which is often hard to establish in larger groups and organizations. Aircraft maintenance is done by individuals or small groups, so perhaps we should investigate the potential of having these small groups as the basic organizational units of the maintenance organizations.

Major Group Research Issues

Cohesion

Cohesion "refers to the degree of intensity with which group members are bonded together and motivated to work as a unit toward achievement of group goals" (Palazzolo, 1981). In other words, cohesion is a large part of the groupness or "we-feeling" that develops in groups. Level of cohesion is correlated with task productivity, satisfaction, and morale. The Army has been interested in cohesion for some time and currently has research efforts underway (Henderson, 1979, 1985; Kelly, 1988; Seibold, 1988). Cohesion is an important element in all groups but is of particular concern in groups in combat.

Several questions quickly come to mind when we examine the functioning of groups in combat. Cohesion is one of those group factors which is known to increase performance. If that is the case, we should be doing our best to create cohesive groups and asking the right questions. Is the stress of combat (or other stressors) a facilitator of or a detriment to cohesion? It may depend largely on the effectiveness of the leader in the stress condition. If the leader is overcome by the stress of combat, the group may be ineffective. If the leader creates a leadership vacuum by inactivity or inability, then what are the probabilities that another group member will take his place? If a leadership vacuum is created by the leader being killed or wounded, a completely different scenario may take place. In the latter case, if there is high cohesion then the group will probably rally around a new leader in a short time. In the former,

the leader will have created doubt, or apprehension, and his being overcome by fear may pervade the esprit of the team/group and undermine their cohesion and effectiveness. Why does cohesion develop in some groups and not in others? Why does cohesion develop at all...why is it not, as Hume (1986) suggests, a war of all against all, that is, everybody for themselves in a totally selfish system?

Leadership

Leadership is one of those areas which quite logically cuts across levels of analysis. Research has been done on individual characteristics of leaders and on the group dynamics which affect the emergence, style, and functions of leaders (Bass, 1981). Systematic examination and integration of leadership studies from multiple levels of analysis is critical to bring coherence to the area. Leadership can be conceived of as a potential which exists in people at varying levels and which is elicited by the characteristics and demands of the group or organizational conditions. All AFSs could benefit from being exposed to the individual, group, and organizational statics and dynamics of leadership in the AF. Research on the difference between the group and organizational characteristics of task performance and their leadership requirements would enable trainers to focus on those during formal training. This multiple level research strategy should yield an effective base for the development of leadership training at all rank levels in the AF.

Group and Training Research Questions

What are the different types of groups in the AF and how can research enhance their missions? There are many research questions here. Below are a few of the most pressing:

*Can task performance skills and knowledge be acquired better, quicker, or retained longer when learned in a group environment?

*What type of data are needed to determine the above?

*Can groups trained together transition to operational environments together?

*If the above is done, should there be some systematic selection of maintenance teams, forward air control ground teams, air rescue teams, med evac teams, security police squads, etc., prior to training? If so, how?

*Should these people go through basic training together?

*What are the performance effects of varying levels of conformity, leadership, coalition formation, etc.?

*What are the effects of high technology environments on the same factors?

*What group dynamics are important in a groupware environment and why?

ORGANIZATIONAL LEVEL OF ANALYSIS

The prevailing attitude about many organizational studies is belied by the practice of many psychologists pronouncing "organizational climate" as if it is something distasteful they are

spitting out...Pfft...Pfft! Obviously, we don't agree with our esteemed colleagues who hold that position and feel that there is much which analyses at this level can contribute to the AF training mission.

Most people are members of at least one organization throughout their lifetimes. Organizations are constant and pervasive parts of our lives. It is not surprising that social scientists have given much attention to these abstract, yet important social systems. Research on organizations has come into its own in the past half century with several important works dating even further back (Max Weber's writings on bureaucracies is one example). Organizational research covers a wide spectrum of issues depending upon the perspective and aim of the researcher. Research topics include the behavior of individuals and groups within organizations, organizational structure and dynamics, intra- and inter-organizational relationships, organizational culture, and others. In this section, we will discuss the nature of organizations, identify important organizational characteristics, examine the relationship between organizational and other levels of analysis, and explore the utility of organizational level perspectives in addressing training and mission capabilities issues.

What Organizations Are

Schein (1980, p. 15) defined an organization as "the planned coordination of the activities of a number of people for the achievement of some common, explicit purpose or goal, through division of labor and function, and through a hierarchy of authority and responsibility." Schein's definition provides us with a parsimonious description of what an organization is. It tells us that organizations have structure, are composed of numerous individuals, and work toward a goal. Yet, organizations have complexities and dynamics which cannot be captured by definitions alone. Understanding the nature of organizations, beyond its definition, is essential to analysis at the organizational level. Organizational research and our understanding of organizations has been shaped by inputs from a number of different sources. Important inputs come from the early case studies of sociologists, traditional industrial psychology, Elton Mayo's work on group dynamics, surveys of morale and motivation, and comparative studies of organizations (Katz & Kahn, 1978).

It was a biologist, Ludwig von Bertalanffy, who made the most profound impact on our present understanding of organizations. Bertalanffy advocated the idea of a general systems theory in which the biological concept of a system would be used as a framework for studying scientific phenomenon at all levels (Jewel, 1985; Katz & Kahn, 1978). A major feature of von Bertalanffy's general systems theory was the openness of all systems—that is, the dynamic interaction between the system and the environment. This theory eventually led to the conceptualization of organizations as open systems (Jewel, 1985). For example, Katz & Kahn (1978, p. 20) have described organizations as "flagrantly open systems in that the input of energies and the conversion of output into further energic input consist of transactions between the organization and its environment."

Characteristics of Organizations

Organizations exhibit two basic and important features as open systems. First, organizations have a reciprocal dependence with their external environment (Jewel, 1985; Milton, 1981). The environment provides the inputs—humans, raw materials, energy, capital, information—which are used by the organizations to accomplish their organizational goals. That is, organizations use resources obtained from their environment to produce either a product or service. This product or service is then exchanged with the environment for more resources. The end result is a mutual exchange relationship (and dependency) between the organization and its environment.

The environment itself is complex and multifaceted. The environment, as used in this context, refers to more than the immediate physical or geographical location of the organization. It also includes the social, economic, cultural, and political conditions surrounding the organization.

The second feature of organizations is that they have numerous interrelated parts. Kast and Rosenzweig (1973) identified five general subsystems which operate within the organizational system: technical, goals and values, psychosocial, structural, and managerial. These parts, acting in an ordered pattern, transform environmental inputs into organizational goals or outputs. Outputs may have both material and social characteristics (Milton, 1981). For example, the output may be a tangible object such as an aircraft or a trained technician, or it may be an intangible product such as productivity, satisfaction, or individual development.

Organizations and Training

Training is a subsystem of the organization, according to Goldstein (1986). Training systems do not exist in a vacuum. They affect, and are affected by, other organizational factors. Organizational goals, management style and structure, resource availability, organizational climate, organizational culture, and internal and external constraints are all among the factors which may impact training programs. These factors ultimately affect the behavior and performance of individuals within organizations, as well as organizations themselves, and therefore, warrant the attention of researchers involved in training and mission effectiveness issues.

Jewel (1985) and others, for example, have argued that individual behavior is a function of, among other things, organizational climate. Admittedly, the concept of organizational climate is difficult to pin down and even harder to measure. Nonetheless, this concept, as well as others at the organizational level, deserve consideration. The factors which influence this climate may well explain the failure of multimillion dollar training programs or help in the construction of others.

In an in-depth study of three federal agencies, Salinger (1973) discovered several organizational factors which brought about disincentives to effective employee training and development. He found that the top management failed to budget and plan appropriately for training or to provide rewards for effective training because the benefits of training and development were not clear to them. Consequently, supervisors were not able to perform their jobs effectively while their employees were being trained. Moreover, the lack of top management involvement in the planning of training resulted in the teaching of techniques and methods contrary to organizational practice (Goldstein, 1986).

Training is intimately linked to organizational factors. Goldstein's Training in Organizations (1986) presents a comprehensive look at the relationship between organizations and training for persons interested in exploring this subject further.

Organizations and Training Research Questions

Organizations pose a number of questions for researchers of AF training and mission effectiveness issues. Below are a few such questions which should be addressed when evaluating or developing training programs:

*Are there unspecified organizational goals which should be translated into training objectives or criteria (Goldstein, 1986)?

*Are the various levels in the organization committed to the training objectives (Goldstein, 1986)?

*Have the various levels and interacting agencies in the organization participated in the development of the training program (Goldstein, 1986)?

*Is the training program violating any of the norms or values of the organizational culture?

*Is top management willing to commit the necessary resources to maintain work organizations while employees are being trained (Goldstein, 1986)?

*Is the organizational climate conducive to the training program?

*What internal or external constraints are impeding training?

COMMUNITY LEVEL OF ANALYSIS

What Communities Are

Communities are groups of people who occupy certain territories over time. Warren (1972) defines five functions of communities: (1) a system of production, distribution, and consumption, (2) a system of socialization, (3) a system of social control, (4) a system of social participation, and (5) a system of mutual support. A community is at the same time a territorial unit, a social system, and a network of relationships. The size of communities varies greatly from a very small commune to a huge megalopolis.

Sociologists discuss differences between communities and have defined the folk-urban continuum (Redfield) which classifies communities by cultural complexity, geographical isolation, types of sanctions used for social control, and patterns of interrelationships. In addition, Tonnies (1887) described the major two types of social relationships found in varying degrees in different types of communities. Gemeinschaft described intimate, cooperative, and personal relationships and Gesellschaft described competitive, impersonal, self-serving relationships. Sociologists have postulated that rural communities have more Gemeinschaft and urban communities more Gesellschaft relationships.

What might this have to do with the AF and with training in particular? When the AF builds a base on U.S. territory or more particularly on foreign territory it is building a community. This AF military community is different from many civilian communities, but the functions and requirements will be substantially the same. In fact, many early communities of the preindustrial era were walled fortresses on the coast or at strategic trading locations on rivers and lakes. As temporary or permanent bases are established all the requirements to run a large community must be put in place and often in a short period of time.

We are saying here merely that this level of analysis should be a consideration in evaluating the effectiveness of operational and training practices. It is quite possible that airmen from rural, urban, or suburban community settings coming into the AF will have dramatically different perspectives and be more or less effective because of it. It is also a distinct possibility that the types of relationships an airmen is used to in his or her home community may be quite different from those in the "communities" they experience in the AF on the base or in the town, city, or rural area in which the base is located.

Communities and Training Research Questions

*Are airmen from different cultural, ethnic, or racial backgrounds represented in the AF in proportions similar to communities in the AF?

*Are airmen from communities with mixed or similar racial, ethnic, and cultural backgrounds more or less successful in the AF?

*Are there different degrees of successful performance of airmen based on the type of community (i.e., rural, urban, or suburban) or region of the country from which they were recruited?

*Are airmen who have moved around from community to community while growing up as opposed to those who have lived in only one community more likely to enjoy the AF with it's frequent moves? Are these airmen more likely to reenlist?

SOCIETAL LEVEL OF ANALYSIS

Societies are what most of us think of when we think of citizenship, patriotism, and allegiance. We are members, by birth or immigration and naturalization, of something larger than ourselves and our immediate families. We often have a sense of it but find it hard to articulate exactly what it is. Sociology is the behavioral science which investigates social systems. Analyses at this level may prove quite useful to the AF training community in understanding, predicting, and resolving certain types of training problems.

What Societies Are

Societies are groups. Modern societies are usually very large groups but groups nonetheless, which have roles, statuses, and structure in which individuals move in social space. As with small groups discussed earlier there are a number of definitions of societies. According to Theodorson and Theodorson (1969, p. 398) a society is:

> "A group of people with a common and at least somewhat unique culture who occupy a particular territorial area, have a feeling of unity, and regard themselves as a distinguishable entity."

Hoult (1972, p. 306) denotes society as either:

> "A) human beings in general considered as a group, together with all the social relationships maintained among the persons and subgroups making up the total, or B) any one of a number of relatively independent, self-perpetuating human groups each of which 1) has its own territory, 2) is made up of persons of both sexes and all ages, and 3) maintains its own way of life in terms of a culture that is more or less unique."

There are many other definitions and consistencies and some differences but again, as with groups, it is not important to settle on a definition here. When used, the term should be defined and assumptions stated for other researchers. The AF has as its primary mission the defense of that territory which our society occupies. The AF also is composed of people recruited from the great heterogeneous mix of American society, of both sexes, of a variety of ages, and racial, ethnic, and religious backgrounds. It is wise to be well-acquainted with the culture and society and how it changes to best train and use the skills of this rich mixture of talents.

Characteristics of Societies

Sociologists have characterized societies as having institutions. Institutions are roles and norms focused around a social need or function. All societies have some form of these institutions because they fulfill basic social needs. Most sociologists agree that there are five basic institutions: family, economy, government, religion, and education. There are many different forms of all of these institutions but they all fulfill a social function but in a different way.

The family serves to regulate sexual behavior, pattern reproduction, socialize children, provide care and protection, provide social status, and in preindustrial societies serve as the unit which organized production and consumption. Kinship and marriage systems are found in this institution. The economy provides the mechanisms through which goods and services are produced and distributed. Modern societies fall somewhere on a continuum from an ideal capitalist to an ideal socialist economy. Government and the political process are the roles and norms associated with making decisions which affect the entire society. There are many different forms of government and many functions of its most frequent modern form, the nation-state. The nation-state establishes laws, provides social control, sets goals, protects against outside threats, and ensures economic stability. Religion is the institution which offers explanations which allow societal members to comprehend their place in the universe and the meaning of life. There are different forms of religion and functions it performs in addition to defining world views such as being a socially cohesive force, a socializing agent, and exercising social control. Education is the institution in which formal socialization to become a societal member takes place. The norms, roles, statuses, values, history, and required technical abilities are transmitted to the younger generation during education. There are other major social innovations which have become quite important in modern life such as science, medicine, telecommunications, and the military which are considered institutions or significant parts of basic institutions by some sociologists.

Societies and Training Research Issues

Sociologists also examine social change and fluctuations in many patterns of behavior within and between societies. Social change refers to the changes that take place throughout all levels of the society in its institutions, organizations, statuses, roles, and values. One of the most important, and for the AF training mission, significant areas of social change research is in population changes. Demography is the area of sociology which focuses on population changes.

Demography

Of particular importance to the AF is the available recruit pool and its significant characteristics. Demographic projections indicate a reduced pool of 18- to 22-year-olds in the 1990's. These projections are part of the reason for AF initiatives such as Small Unit Maintenance Manpower Analyses (SUMMA) and Rivet Workforce. These programs seek ways to get the technically difficult and demanding job of aircraft maintenance done with fewer technicians who have broader ranges of skills. The training implications for such a workforce are substantial.

In addition, demographic projections for after the 1990's and into the 21st century are for increased proportions of 18- to 22-year-olds. However, this group will reflect the continued shift of the population to a greater percentage of Hispanics and blacks. Conservative estimates show an increase in the percentage of Hispanics in 1980 of 7.7% to 10.4% in 2000. Blacks show an increase from 13.8% in 1980 to 16.0% in 2000. Conversely, whites show a decrease from 76.6% in 1980 to 70.2% in 2000 (Binkin, 1986). Another demographic projection from the Census

Bureau (Spencer, 1984) projects the percentage of blacks and all nonwhite races at 16.9% in 2000 increasing to 18.3% by 2030.

It is imperative that we explore these areas of research and identify the nature and degree to which critical training issues will be influenced. Demographic forecasts and likely sociocultural influences should be identified for at least the next forty years, through 2030. Census Bureau projections usually are available for 100 years into the future. The projections are based on certain assumptions about birth rates, death rates, and immigration rates and normally are forecast in low, medium, and high growth rate potentials. These projections will allow AF analysts to explore a range of options for a range of possible future population scenarios. The variety of training issues which could be addressed by focusing on the societal level of analysis are as diverse as the American society and the AF itself.

English as a Second Language

Another concern of the AF is in the lower high school graduation rates and high rates of English as a Second Language (ESL) in this increasing subpopulation. The AF already competes with industry and the other branches of military service for technically capable young men and women. In the future these numbers of technically capable young people may substantially decrease. Training requirements, training evaluation, and training effectiveness may change. The AF will face difficult questions. Does the AF bring ESLs up to speed in English and related skills? Does the AF become multilingual? Or is there some combination of these two extremes or other options which should be pursued?

Holland (1984) in a study for the Army assessed the effectiveness of their existing ESL programs. They found that ESL soldiers who went through the ESL training programs did significantly better in Advanced Individual Training (the same as Airman Basic Residence training in the AF) than ESL soldiers who did not go through the same training.

Literacy

In addition to, or accompanying the projected demographic shifts are projections of changes in overall literacy rates which is a significant component of basic skills. If "Ripley's Believe It or Not" is to be believed, you are among the lucky few who can read this type of manuscript. Ripley's says that by the year 2000, two-thirds of all Americans may be illiterate (1989). Various researchers (e.g., Mikulecky, 1987) have pointed out that these gloomy predictions need to be closely examined for which subpopulation they focus on, what part of the country, the definition of literacy used, the measurement technique and so forth because there is a tendency for overgeneralization in the press. However, even if the figure is not two-thirds, and is even half of that, it is alarmingly high and unacceptable. The hard fact is that the AF needs literate trainees. If we do not recruit literate trainees then we're going to have to create literate trainees. They have to be literate to absorb the training and do the work. On the surface, this may appear to be exclusively a selection and classification problem. However, the problem will not be solved by better selection or classifcation if such a large proportion of the existing recruit pool is in such bad literacy shape.

The AF is going to have to bring recruits up to literate speed by using new and innovative training technologies. Here's one such possibilty: a computer-based total-immersion literacy training environment (TILTE) similiar to that used to teach foreign languages. Put recruits into a training situation in which they can only communicate with the instructors and each other by use of information which is read on flat computer display screens mounted on their chests. A small ruggedized computer with the appropriate software is carried on a backpack or belt. The

input device is a small keyboard into which they type everything they want to "say," which is then displayed on the screen on their chest. Everything they "say" is stored and evaluated later by the instructor who provides feedback through the same medium. Reading and writing lessons are provided in individual and group sessions in which the trainees can plug into a network and larger display screens. To keep interest and motivation high some of the lessons are directed towards technical training for their future specialty. Appropriate artificial intelligence tie-ins can be built in as diagnostic tools to replace instructors in some cases. Other devices also could be accessed with the literacy computers such as interactive video disk lessons.

WORLD SYSTEM LEVEL OF ANALYSIS

The analysis of the world system is a relatively recent area of research in the behavioral sciences. Wallerstein (1974) proposed that modern societies could only be truly understood by examining them as parts of a total global system. Since his original work, world system theory has caught the attention of many young sociologists, economists, and political scientists and is being refined and tested.

What the World System is

Wallerstein (1979) argued for a higher level of analysis than was provided by most of his contemporaries. He proposed that the world become the primary unit of analysis. This world system perspective "stresses the independent significance of the world capitalist system and its impact on socioeconomic processes in all nations—core, peripheral, or semiperipheral" (Koo, 1984, p. 36). Each nation-state, according to Wallerstein's model, exists at one of these three levels. However, because of the dynamic and cyclical nature of the capitalist world-system, nation-states are not frozen into either one of these categories (So, 1986). They can experience upward and downward mobility, moving from periphery to semiperiphery to core and vice-versa (unlike the more deterministic dependency model proposed by Andre Gunder Frank). The capitalist world-system experiences periods of expansion and contraction due to the imbalance of world effective demand and supply of goods (So, 1986). The cyclical nature of the world economy facilitates the shifting of nation-states within it.

Wallerstein argued that the internal conditions of any peripheral or core country can be understood in terms of its position in the world economy (Koo, 1984; So, 1986). Friedmann, for example, noted that "a nation's structural location within a pattern of relations crucially determines a wide range of its putatively national characteristics" (1988, p. 304). Analysts have demonstrated this relationship in the areas of economic growth, urbanization, income distribution, political regimes, and revolutionary transformation.

The World System and Training

The world systems level of analysis may not be directly useful to enhancing the AF training mission. It does offer, however, a level of understanding of the international situation in which the AF may find itself playing a defensive or offensive role. It also may offer insight into probabilities for immigration and emigration rates, international economic dynamics, or possible hot spots for conflicts and the types of training required for missions in those social and physical environments.

The relationship between phenomenon at the world systems level and lower levels is not always readily apparent, and therefore, this layer of analysis is easily ignored. However, these sorts of relationships do exist and may very well impact on AF training and mission effectiveness. The proposed import tariffs on Japanese high-tech and other manufactured goods, for example,

may impact the AF in significant ways. If high import tariffs are imposed by Congress, Japanese firms would be forced to react. One likely reaction would be for Japanese firms to bypass import tariffs by opening business ventures inside the U.S. (a strategy commonly used by multi-national corporations). The influx of these high-tech and manufacturing firms would create intense competition for technically competent young men and women. Recruiting and training programs in the AF would have to be restructured in order to deal with the changing composition of the recruit population.

The changing nature of warfare is another, more tangible, example of phenomena at the world systems level. Over the past several decades, we have seen the emergence of new forms of warfare which are characterized by guerrilla tactics and terrorism. This shift from conventional to unconventional forms is the result of a number of factors including economics, politics, ideology, and technical advancement. The implications for the U.S. are tremendous. We have already witnessed the growth of the U.S. Special Forces and rapid deployment forces in response to changing threats. The change in our force composition has, in turn, necessitated a change in our training programs to enable us to fight and win these Limited Intensity Conflicts (LICs).

World Systems and Training Research Questions

Phenomenon at the world systems level can affect AF training in a variety of ways. Granted, the methodology for studying these macro-level issues is not as developed as lower level methodologies. Nonetheless, research on the world systems level warrants the attention of AF researchers. We have listed a number of possible research areas below:

*The identification and study of world phenomenon, such as migration patterns, which will affect the demographic composition of our recruit population (e.g., increased proportion of ESL persons).

*The study of factors (military, economic, ideological, technological) which may necessitate a change in US military policy and military force composition, thus requiring modifications to our training programs.

*The study and forecast of technical advancements which will change the nature and content of training.

*The study of the impact of strategic resources and production in other countries on our ability to carry out training programs and other AF missions.

THE FUTURE

With an eye toward the future, we could also expect another level of analysis to be required which would involve space exploration and the colonies which will develop.

Space System Level of Analysis

Space stations and vehicles and lunar and planetary habitations are in our not-to-distant-future and along with them new sets of challenges and problems. This level of analysis focuses on the structure and dynamics of human exploration and habitation of extraterrestrial environments. As we move into space in greater numbers we may exhibit patterns of growth and exploration

similar to the colonization of earth as new frontiers were discovered and inhabited or life in space and on extraterrestrial environments may be so greatly different that new patterns will develop. Initially, space colonies will be greatly dependent on mother earth but if history is any teacher (as Santayana says it is), then we should see unique cultures develop along with pressures to define themselves as distinct societies with the accompanying social movements towards independence and self determination.

This "Space System" level of analysis may seem far fetched, but consider the many dollars, rubles, pounds, yen, and francs that presently are going into space exploration. Some projections suggest a space population in the thousands by 2030 (Weil, 1982). It does, indeed, seem to be a direction that all of our species are interested in going.

There are, however, conceptual and practical problems of understanding what is happening which are different from other levels of analysis. The difficulties and dangers of space travel and life on alien worlds will in some ways be similar to the dangers and travels experienced by earlier earth-based explorers. There will be significant differences created by dependence on machines and artifical, controlled environments for air, food, and water; there will be vast distances to be traversed; basic survival practices must be adhered to without exception; there will be populations composed of highly talented scientists, technicians, and military personnel all of which make life as a "spacer" quite different.

One of the current challenges for behavioral scientists is to define the unique characteristics and dimensions of this level of analysis. Many very interesting questions arise when we look at human habitation of space as creating a new level of analysis of human behavior. Can the direction of growth of space colonies be predicted by existing knowledge of human growth patterns? Will they remain tied to the nation-states which sponsored them? Will stratification systems develop similar to those on earth? Will the "spacers" become the leading edge of humanities evolutionary push and be considered a new elite? How will "spacer" culture be the same as or different from earth-bound cultures? Many of the questions and issues have a direct impact on training and the ability of the AF to accomplish future missions.

Some possibilities for early research may exist in examination of the only environment which is in many ways similar to the future space enviornment...the Antarctica research station(s). The physical demands, separateness, ties to nation-states, and multinational character, and potential for exploitation, all make the Antarctic similar to possible future space living conditions. Another possibility is the long-term studies of underground isolated living in the research biosphere (completely self-contained living environment) being constructed near Oracle, AZ. These examples have similarities to life in space, but we should also keep in mind the differences. It is a little like the difference between couples living together or being married...the big commitment hasn't been made. The dangers of spacelife, lifetime commitments, separation from kinfolk, all make these observations useful but only instructive not definitive.

We would be wise not to scoff at the potential differences of spacelife or the other ruminations of social science fiction writers such as Bradbury (1958) and Asimov (1982). These writers have a gift for seeing alternative futures and telling good stories about those alternative futures. Some past writers have been pretty close to the mark in guessing what the future would be like. Hence, the need for yet another level of analysis which the AF (Aerospace Force?) may wish to consider in dealing with the myriad array of future training problems.

AN ONION ANALYST'S NIGHTMARE

The Elephant Built by Groupware

Dr. Bink Wennett was a well-known "bench-level" scientist at the Armstrong Laboratory and one who was well-practiced at wearing new glasses to see the layers of the analytic onion.

One evening, after a jalapeno and sushi pizza with extra goat cheese, he fell asleep and had a particularly scary nightmare about a work unit that could only be described as "the task from hell!"

Flybynite, Inc. was working on a "Developers Assistant." This is a system which allows a number of development engineers to work on a project simultaneously from dispersed locations. They actually see what the other engineers are putting on the screen. Meetings can be held, briefings given, discussions conducted, etc. Flybynite found that there was a lot of software out there, called "groupware" which allowed groups to interact in this fashion. Elements of the software could also be used for training they found and it did not apply just to developers...it could be used by any work group using computer applications. Flybynite went ahead with the selection and purchase of a groupware package to accompany their "Developers Assistant" but began to run into some problems after it was delivered. They delivered the "Developers Assistant" to a kitchen utensil engineering branch of the Armstrong Laboratory known as AL/KUT, whose branch motto was "We're a KUT above the rest." The "Developers Assistant" software itself worked extremely well, but the first item they designed, the Advanced Technology Spatula (ATS), turned out to have major flaws. The composite materials coating which provided the stealth capability required to sneak up on frying eggs was melting off in the presence of low density lipoproteins and the flying wing design of the lift surface was allowing too many eggs to slide off and assume flight profiles of their own. KUT complained to Flybynite and both brought in some high-powered management consultants who noticed only that the engineers seemed to interact oddly while using the system but they weren't sure exactly how or why or if that could affect the design of the ATS. Otherwise everything was hunky-dory. Being hardware and software engineers and focusing on each individual's ability to access the system, touch the screens, and move from program element to program element, Flybynite did not include any of the social psychological dimensions of the product they were creating.

Flopping around in bed, beating his pillow, sweating profusely, and moaning..."they'll kill me at program call, they'll kill me at program call," Bink wakes up and remembers his new glasses and puts them on just in time to see the layers of problems revealed by the analytic onion and the nightmare has a happy ending. Some "fall out" money becomes available, and he is able to pull his fat out of the fire before it begins to sizzle. His new glasses allow him to see that basic group dynamics such as conformity, leadership, coalition formation, and communication networks which had not been considered in the first contract needed to be included in the follow-on effort. Bink sleeps well the next evening.

There has been research conducted on Asch's classic conformity experiment with a twist which simulates something similar to Flybynite's situation, that is, the subjects were not in each other's physical presence. They spoke via microphones and headphones and saw the "standard and comparison lines" on a video monitor. The conformity rates were substantially higher than in earlier research (Lamb & Alsikafi, 1980). If this is the case in a simple conformity experiment, what are the implications in a complex task situation? It is reasonable to assume that the lack of physical presence of other people and the presence of high technology products such as recording devices and computer monitors creates additional pressure to conform. Social psychologists tell us that a great deal of communication takes place via nonverbal messages which, of course, are absent from this medium. If video communications are used, then nonverbal communication will be distorted and may confuse and confound the interaction process. It is possible that some people familiar with such devices may not be intimidated, but the group dynamics themselves still may be distorted or influenced. It could also be argued that the lack of physical presence of certain individuals may make it easier to disagree, that is, to be independent. In real world applications the organizational structure in which these individuals work is also a factor. What group dynamics are important in "groupware" applications? The normal dyadic and triadic low level conversations which normally occur in groups and are

important in defining areas of agreement, disagreement or confusion and coalition formation will be absent during group sessions...these will only be possible before or after the group sessions.

FINAL THOUGHTS...FOR NOW

By looking at AF training needs and options from different levels of analysis we see the same problem through several different sets of glasses. The problem itself may appear at one level and not even be seen at another. Additionally, solutions to a problem may be more effective, efficient, or cost effective when solutions focus on one level rather than another. Therefore, AF training requirements, evaluations, methods, problems, and solutions should be examined from more than one level of analysis.

There are other real life issues that current AF research on training is facing. For example, the alternative AF specialty structures as presented in SUMMA and Rivet Workforce (Lamb, Eckstrand, Seman, & Lindeman, 1987; Boyle, Goralski, & Meyer, 1985) and the changes being considered in aircraft maintenance that would introduce two levels of maintenance, that is, flightline and depot as opposed to the current concept of flightline, shop, and depot. Such dramatic changes in specialty structures and maintenance concepts would certainly have an effect on maintenance training requirements. Other training options available to decision makers such as deleting technical school for some AF specialties or increasing it in others to the point of training them all the way the a 5-skill level (fully qualifed) need to be examined in light of different levels of analysis. Other training issues include the development of increasingly complex technology, built-in-test equipment, job performance aids, the utility of various training aids (such as Interactive Video Disk and Computer Assisted Instruction), and the varieties of settings in which AF training is delivered (i.e., residence school, field training detachment, on-the-job training).

Training issues, problems, and solutions are found at all levels of analysis. Researchers should identify the levels of analysis relevant to their issues and training problems and seek appropriate solutions. It is entirely possible that the problem will be conceived quite differently at different levels and that very different variables will be involved. It would be unwise to settle on one level of analysis for all training problems because that is our area of expertise. Most of us work in interdisciplinary settings and can access the expertise of other professionals. We are concerned with arriving at cost effective training programs which yield the best trained airman to accomplish a variety of organizational missions...in some cases this requires analyses at the individual level and in some it requires insights, concepts, theories, or techniques from other levels of analysis.

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